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STUDY GEOMORPHOLOGY, PAST AND PRESENT, LINEAR TRENCH,
TECTONICS RELATIONSHIP BETWEEN PYRENEES AND ALPS

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FINAL REPORT

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14. Supplementary Notes LAST PHOTOGRAPHS OF MARCH 21 th 73, RECEIVED ON JUNE 17 th 73. MOSAICS AVAILABLE ON AUG.73 -				
15. Abstract The aim of PYRALP is a geological study of relations between two mountain ranges Alps and Pyrenees. The images received do not cover completely, without clouds, the Eastern Pyrenees - Linear trends common to both ranges have been delineated on mosaics, and field investigations are presently made in view of understanding their geologic signification.				

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O - PREFACE

0.1 - Objectives of the project PYRALP

A lot of geological and photogeological investigations have been made on the area extending from the Eastern Pyrenees to the Southern Alps, but the mechanism of the tectonics is much debated. The aim of the PYRALP project is to study the overall relations which exist between the Pyrenees-Provence tectonic zone and the Alpine zone in the southern part of the Alps and between the main Pyrenees range and the Corbieres in Languedoc.

0.2 - Scope of activities

First data received from OCT.25.72 to JUNE 01.73 were set up as a mosaic which was available only on JULY 73, due to gaps in coverage. Therefore the study actually began on AUGUST 73. Meanwhile partial works were carried out in some places where images were available. Gravimetric, aeromag surveys and statistics of occurrence of seims are presently compared with the main lineaments discovered previously.

0.3 - Significant findings

ERTS images obviously show up some large linear features trending N 80°E or N 30°E common to both Alps and Pyrenees. One of them, the "Ligurian Fault", had been previously forecast by Laubscher in an interpretation of the Alps by the "plate tectonic theory". But it extends westward farthest from the Alps, cutting the Pyrenees axis. We have interpreted these lineaments as reflections of deep seated wrench faults in the surficial part of the sedimentary series. A large set of such lineaments is perceptible in western Europe such as Guadalquivir Fault in Southern Spain, Ligurian Fault, Insubrian Fault, Northern-Jura Fault, Metz Fault (see BRGM report MMC 003-1), etc.... Perhaps they may be interpreted as transform faults of the mid Atlantic ridge or of a paleo-rift seated in the Rhine - Rhone graben.

0.4 - Conclusions

We are presently at the end of the "official" project and this investigation has pointed out many fundamental geological problems, as it was expected.

Nevertheless, the main work is just beginning and our knowledge of the tectonic relationships of Pyrenees and Alps resulted for any time in more trouble than success. We think that many years of investigations will follow in correlating ERTS data and other surveys.

0.5 - Recommendations

- i) our planning of the operations has not been followed because of the irregular data receipt. For a geological investigation it will be better to wait sometimes the satellite has a lot of picture taken and then choose the better of them to set up mosaics and begin the investigation.
- ii) we have misunderstood the system of reports and we don't have sent them when no results were available or when the results have been published at the ERTS Symposium. We suggest that for the future, type I report could be replaced by the filling of a form like the "standard title page" and type II replaced by type I as a cover and published results if any or a report only if necessary (no significant results, but significant problems). The scope of activities, the problems encountered will be discussed, in the general case, only in the final (type III) report

.../...

1 - OBJECTIVES OF THE PROJECT PYRALP

A lot of geological and photogeological investigations have been made on the area extending from the Eastern Pyrenees to the Southern Alps, but the mechanism of the tectonics is much debated. The aim of the PYRALP project is to study the overall relations which exist between the Pyrenees-Provence tectonic zone and the Alpine zone in the southern part of the Alps and between the main Pyrenees range and the Corbieres in Languedoc.

2 - SUMMARY OF WHAT WAS ACCOMPLISHED DURING THE PERIOD DECEMBER 1, 1972 TO MARCH 31, 1974

2 - 1 Preliminary Data Analysis

2 - 1-1 Data received

ID NUMBER	DATE	RECEIVED	LOCATION
1058-09540	09.18.72	10.25.72	CORSICA-ITALY
1059-09500	09.20.72	11.17.72	UPPER RHONE VALLEY
1060-09554	09.21.72	11.17.72	GENEVA, RHONE VALLEY
1060-09561	09.21.72	11.17.72	WESTERN ALPS, FRENCH RHONE VALLEY
1061-10013	09.22.72	12.07.72	LYON - ST ETIENNE
1075-09390	10.06.72	12.07.72	GENOA - PO RIVER
1076-09442	10.07.72	11.23.72	MILAN - PO RIVER LAKE MAGGIORE
1076-09445	10.07.72	11.23.72	GENOA - TURIN
1076-09451	10.07.72	11.23.72	NICE - VAR RIVER
1078-09555	10.09.72	12.07.72	GENEVA- LYON
1238-09453	03.18.73	06.01.73	MILANO - PO VALLEY
1238-09455	03.18.73	06.01.73	GENOVA - TORINO
1241-10024	03.21.73	06.01.73	LYON - RHONE VALLEY
1243-10141	03.23.73	04.05.73	LIMOGES
1243-10143	03.23.73	06.01.73	MASSIF CENTRAL
1291-09395	05.10.73	06.01.73	GENOVA- PO VALLEY
1293-09510	05.12.73		UPPER RHONE VALLEY
1293-09512	05.12.73		TORINO-WESTERN ALPS
1295-10025	06.01.73	05.14.73	MASSIF CENTRAL

.../...

b) Through POLUMER (009-02) and GOLION (009-01) projects :

ID NUMBER	DATE
1075-09384	10.06.72
1078-09562	10.09.72
1078-09564	10.09.72
1149-09511	12.19.72
1150-09565	12.20.72
1150-09572	12.20.72
1166-09454	01.05.73
1167-09512	01.26.73
1187-10023	01.26.73
1187-10025	01.26.73
1187-10032	01.26.73
1204-09573	02.12.73
1221-09513	03.01.73
1221-09515	03.01.73
1222-09571	03.02.73

2-1-2 Position of the images and short geographical description.

<u>ID NUMBER</u>	<u>DESCRIPTION</u>
1061 - 10013	<p>In the northeastern of the polygon of interest. It represents the southern Jura and a northwestern part of the Massif Central.</p> <p>Main geographical features :</p> <ul style="list-style-type: none"> - mountains : Jura, Grande Chartreuse, Vercors, Monts du Lyonnais, Mont du Forez. - rivers : Rhone, Saone, Isère, Loire. - towns : Lyon , St. Etienne, Roanne. <p>About 10% of the area is cloud covered.</p>

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1075-09390

In the western margin of the polygon. It represents mainly the Italian Appenines and the Po piedmont plain in the North. Genoa harbour is clearly seen.

Main geographical features :

- mountains : Tuscan Appenines, Ligurian Appenines.
- rivers : Po
- towns : Genoa, Pisa, Pavia, Piacenza.

About 20% of the area is cloud covered.

1076-09442

In the northwestern margin of the polygon of PYRALP project. This image extends the image n°1075-09390 to the North. It covers mainly the Italian part of the Alps in the north, and in the south the Po piedmont plain. Main geographical features :

- mountains : Pennine Alps, Bergamo Alps.
- rivers : Po, Ticcino, Addo, Rhone.
- Lakes : Lake maggiore, Lake Como, Lake Lugano.
- Towns : Milan, Bergamo, Piacenza

Less than 10% of the area, higher than 2.000 m in altitude is snow covered.

1076-09445

In the western part of the polygon. This image extends the image n°1075-09390 to the east. It represents the Italian Appenines and Southwestern French Alps. Main geographical features :

- mountains : Ligurian Appenines, French coastal Alps.
- rivers : Po, Tanaro
- Towns : Turin, Genoa, Alessandria.

About 10% of the area is cloud covered.

1076-09451

In the margin of the polygon of interest. The same region as 1058-09450 (see the first type 1 report).

1078-09555

In the northern margin of the polygon. The same region as 1060-09554.

About 10% of the area is snow covered.

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~~FILE~~

- DATA RECEIVED FOR BOTH GOLION AND PYRALP PROJECTS -
Each column is a satellite track
Each line shows the images taken along a parallel

2 - 2 Continuing data analysis and other accomplishments

- A general photomosaic of the area of PYRALP project was made in two stages.

First, an incomplete photomosaic was prepared in March in bands 5 and 6, from the following images :

1060-09554	1075-09393
1061-10013	1076-09442
1061-10015	1076-09445
1061-10022	1076-09451
1075-09384	1078-09562
1075-09390	1078-09564

Second a complete mosaic in bands 5 and 6, was prepared in August 1973 from the following images:

1059-09500	1078-09555
1061-10013	1078-09562
1075-09384	1078-09564
1075-09390	1149-09511
1075-09393	1167-09512
1076-09442	1187-10023
1076-09445	1187-10025
1076-09451	1187-10032
	1242-10085

- The hand drawing of overlays on the mosaics has been accomplished after detailed analysis of most of the images.
- Coherent optical filtering has been made by TRONU project for the enhancement of the main lineament directions (N 30 and N 80) in a complicated area : image 1078-09562 represents the Rhone Valley between Valence and Avignon.
- The investigation of the relationship of the grey levels on each MSS bands and the patterns of the vegetal cover and its nature was made on image N° 1061-10015 by G. LONG, co-investigator of GOLION project, and his colleagues from C.E.P.E..
- Three new test zones have been opened for the ground control of the nature and the behaviour of the main lineament direction. These zones are : the Vans region, which is in the southwestern margin of the Massif Central, the Causse Méjan region farther South than the Vans region, Villefranche de Rouergue in the eastern part of the Massif Central.
In the Vans region aerial surveys were done in September 1972 and March 1973 for color and color-composite images. And during two nights, September 17 - September 18, 1972, March 4 - March 5, 1973, thermography images were made, each time at the beginning of the night and at the end of the night, by Cyclope apparatus (3μ - 5μ) during these two nights, and by SuperCyclope (8μ - 12μ) during the last night.

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For thermography surveys, meteorological stations were installed on the ground.

After photogeological interpretation of these images two ground missions were carried out from April 23 to 26, 1973 and from May 24 to 27, 1973,

Three people, FONTANEL, RIVEREAU, GIRET (I.F.P.) are working on this subject, in collaboration with M. WEECKSTEEN, SCANVIC of the B R G M

In the Cause Méjan region, several special aerial surveys have been done for color, color-composite, thermography imagery. The thermography images were made by a Cyclope apparatus (3 - 5) and were supported by temperature measurements at different depths in the ground.

Three months of geologic missions were carried out in September October 1971, and April 1972, and an additional 15 days were spent at different periods.

This work was done by M. de CHARPAL, I F P

A gravimetric map of the transition zone between Pyrenees and Alps (Languedoc) was digitized-

The likelihood of linear trends on ERTS and linear gradients on the map will be investigated by mean of digital correlation (MARCH 74 - JULY 74)-

Presently, the end of the "official" project, this investigation has pointed out many fundamental geological problems, as expected. Nevertheless the main work is just beginning and our knowledge of the tectonic relationships of Pyrenees and Alps has resulted in more trouble than success.

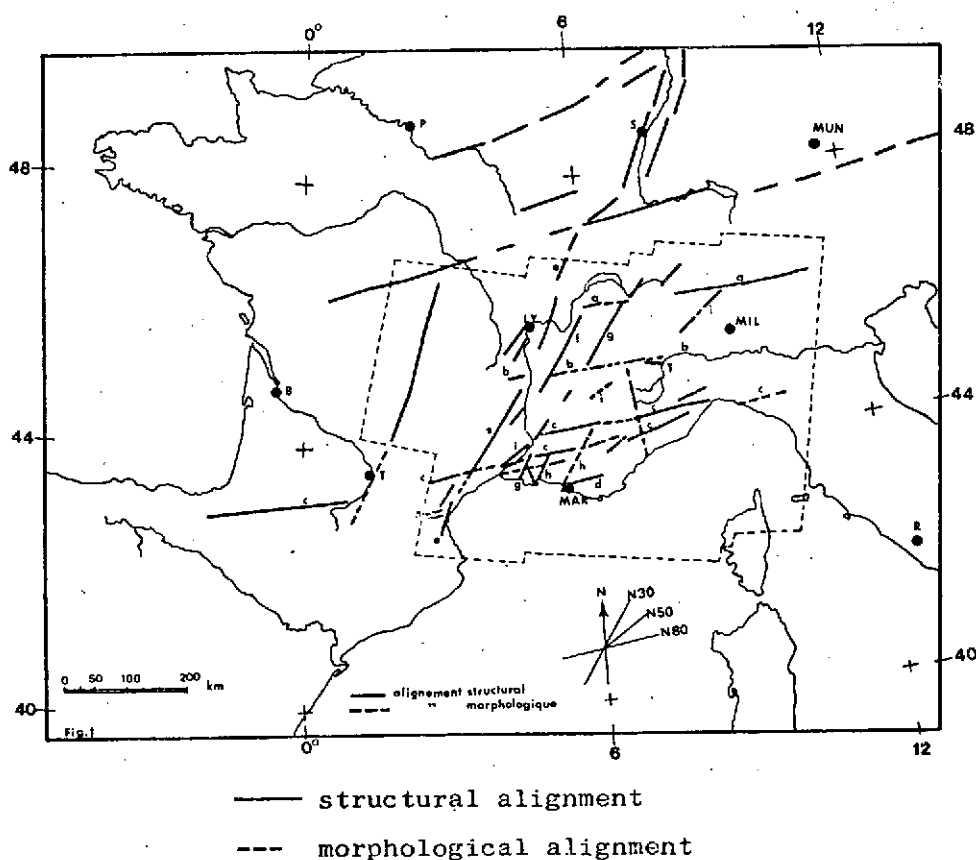


Fig. 1. - Leading structural or morphological lineaments detected.

The letters indicating them are the same ones used for the corresponding paragraphs in the text. The edge of the mosaic of ERTS 1 images is shown by broken lines.

3 - MAJOR PROBLEMS ENCOUNTERED DURING INVESTIGATIONS

The first images of the Pyrenees only arrived in June 73, through GOLION project, so the entire analysis of the polygon on PYRALP area is not yet accomplished. The images of a track from Toulouse to the axis of the Pyrenees are missing.

4 - SIGNIFICANT RESULTS

One of the well-known advantages of vertical airphotos is to illustrate the alignments of structural or morphological features which ground surveys do not reveal with the same clarity. Satellite images on a scale of 1:1,000,000 bring out the alignment of such phenomena over distances of up to several hundred kilometers. In interpreting them, we distinguished structural alignments in the strict sense of morphological alignments, i.e. the first were fold alignments, upturned layers, faults or other geological features, while the latter were lineations in river beds, the relief, vegetation, etc. When a morphological alignment is interspersed within the prolongation of structural alignments, it may be considered to also be of a geological nature.

Figure 1 shows a small-scale map of the location and trend of the main alignments observed. The only features preserved on this map are appreciably rectilinear morphological ones visible over a distance equal to at least 50 km, but the pattern of homogeneous trends that can be seen on the images in our possession is much denser. See figure 2 linears noted on the two "good" images of Languedoc - (1187-10025-7, 26 JANV.73 and 1241-10033-7, 21 MAR 73).

Figure 1 shows that the alignments are grouped in two different-trending families that cut across one another at an angle varying between 50 and 60°. These two families are more or less equally represented and resemble a conjugate fracture system. One family trends 80° N and the other 30°N.

80° N. Alignments

Among these appreciably E-W alignments, the most noteworthy, from N to S, are the following :

a. The "Insubrian Fault" with, in its westward prolongation beyond the Dent Blanche range where the morphology is confused, a fairly clearcut line marked by the northern extremity of the Mont Blanc range and the gorge of the Arve river.

b. An alignment of morphological features that are quite different from each other in nature and origin is visible from NE of Turin (Montferrato) to the crosswise breaks at Chapelle-en-Vercors. It runs via Pelvoux and Belledonne. It is quite singular that beyond the Rhone Valley the accidents bounding the metamorphic basement at Privas and the sedimentary formations are clearly visible in the prolongation of the valley.

c. Two alignments that are almost merged in the Genoa area ("Ligurian Fault") diverge slightly toward the W. They encompass the metamorphic Mercantour range and stand out clearly farther W, with the northernmost being indicated by the Montagne de Lure-Ventoux

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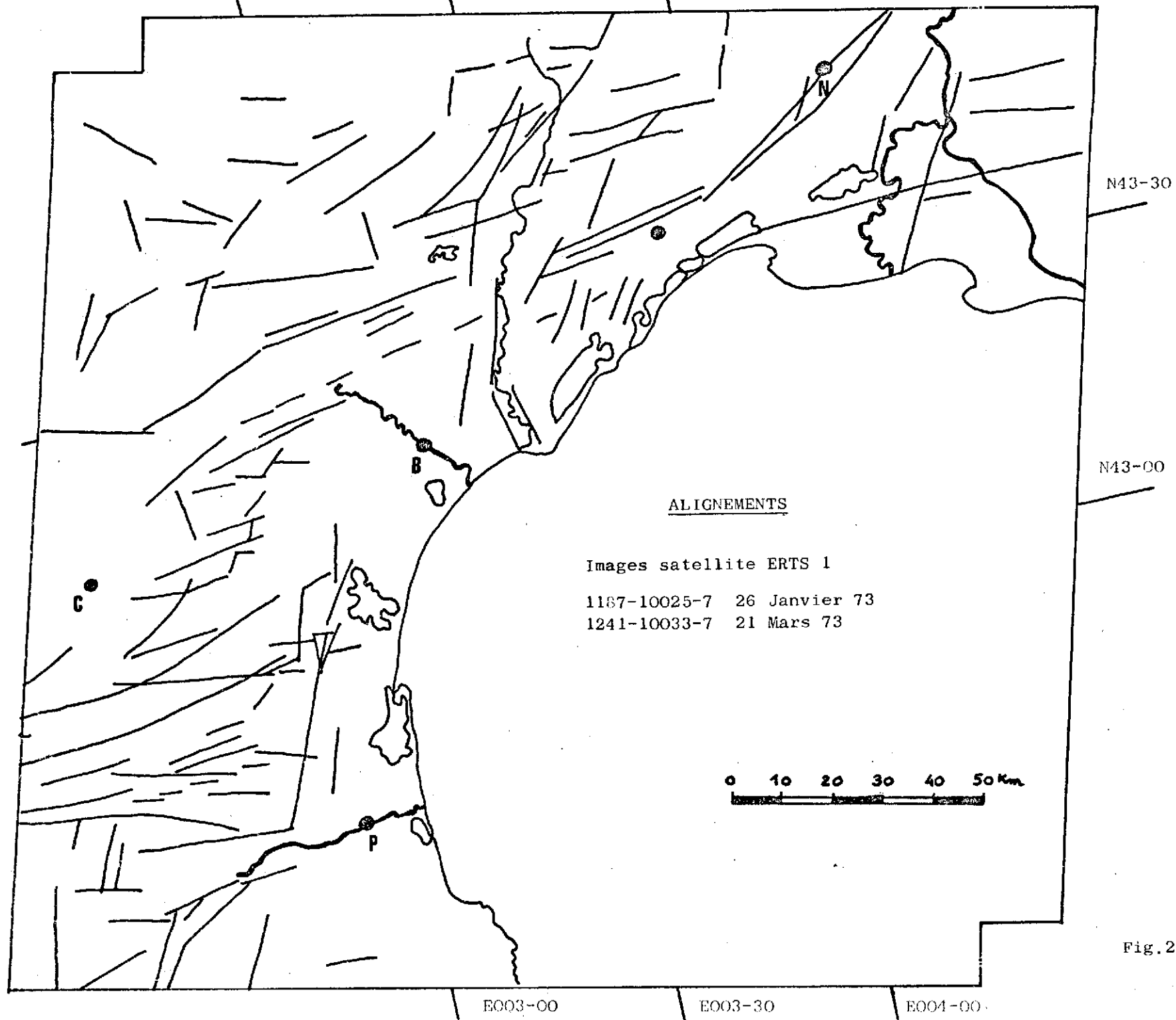


Fig.2

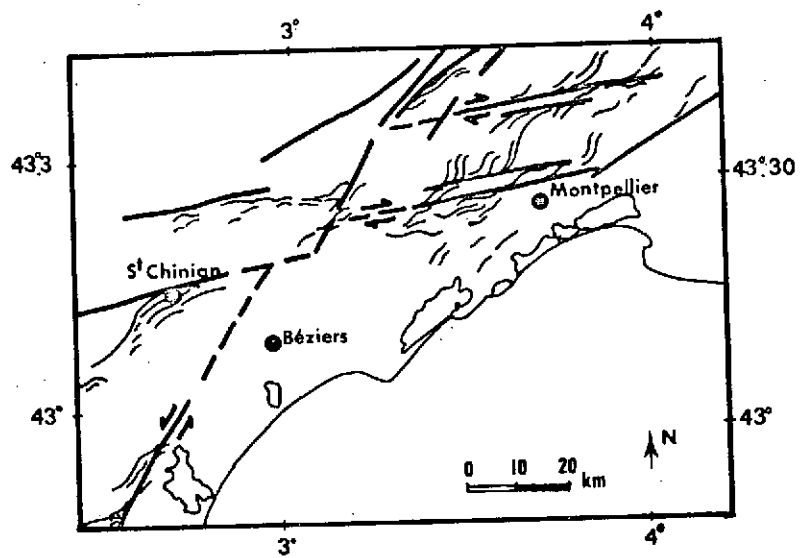


Fig. 3 - Position in arcs or shapes tangent to the lineaments of numerous morpho-structural features in Languedoc.

axis and the southernmost by the alignments of the Asse Valley, the southernmost alignment appears to extend onto the northern edge of the Montagne Noire, and still farther westward by a straight line cutting across the Pyrenees range from Lourdes to Sierra de Aralar in Spain.

d. Lastly, in the S, alignments having the same trend can be seen in the Provençal mountains and W of the Gulf of Lions in the eastern Pyrenees.

The geological or morphological features that follow after one another in outlinings these alignments are extremely varied and only rarely consist of ordinary "faults". Very often, en echelon fold systems or overlapping virgations are studded along them and indicate a preponderant shear direction. NW of the Mediterranean Languedoc plain, for example (Fig. 3), morphological ridges corresponding to the Saint-Chinian scales and then to folds N of Montpellier outline nested S shapes running tangent to delineations. A great many overlaps, even extensive ones, thus probably appear as local epiphenomena linked to these very extensive shear effects.

30° N Alignment

The alignments in this family appear to be more homogeneous with respect to their geological nature. They are mainly breaking disturbances, usually with a sliding appearance. From W to E they are mainly as follows :

e. The transcurrent faulting in the Corbières and the Roussillon are prolonged by the Cévennes fault system which is complex in detail. Farther N in the same alignment are located the disturbances in the Crémieux area.

f. An alignment marked by the western morphological edge of the Vercors, Chartreuse and Bauges mountains.

g. An especially clearcut alignment marked by the Chamonix syncline and the Belledonne fault. In its southward prolongation are located the breaks that halt the Ventoux in the W, and still farther S the "Camargue fault".

h. Lastly, a break separates the Luberon from the Alpilles (Fos Fault), and an alignment runs from Marseilles via the western end of Sainte-Victoire and continues on in the Durance Valley between Vinon and Volonne.

Other Alignments

i. Other trends stand out clearly but do not make up such even and continuous families as the two preceding trends. However, mention should be made of a 50° N trending alignment because it is quite obvious.

.../...

.../...

It is represented in particular by the Nîmes fault between Montpellier and the Suzette Mountains E of the Rhone. In its prolongation is located a clearly visible disturbance on the edge of the Ivree area. Between these two points the alignment exactly runs along the rectilinear southeastern edge of the Pelvoux crystalline formation.

The significance of the 30°N trends has already been mentioned many times. They are the same as the Rhenish graben that runs from the Mediterranean to the Baltic (1), (3), (4). Their leftward slippage is brought out in particular in the Languedoc and the eastern Pyrenees (1). Our surveys seem to confirm this assumption but with a different path for the accidents from the one that had previously been accepted. In particular, they must be distinctly separated from the 50°N trend which is that of the Nîmes Fault.

The role of the E-W trends (80°N) in the Alpine arc formation has recently been proposed (2) (5). What is new about this is the precision provided as to the position of the "Ligurian Fault" and especially the fact that it can be traced for a long way W of the Alpine arc all the way to Spain via the Pyrenean mountains where it appears in particular to contribute to the westward burial of the Axial zone. It is rather surprising, therefore, to see that the most northern alignment corresponding to the very apparent "Insubrian Fault" almost entirely disappears where it crosses the Rhodian network of the 30°N alignments.

Running parallel to this, the eastward-extending "North-Central Fault" described by G. Montjument et J. Sarrot-Reynauld (6) appears to join up with the northern face of the eastern Alps on the molasse basin and is possibly also attached to the Alpine edifice.

The relatively systematic relations of overlapping arcs with these alignments to which they are tangent by one of their ends will lead specialists to seek an explanation for a great many of the overlaps, even major ones, in the surface manifestations of deep shear movements. Consequently, the mechanism by which some allochthonous formations were given their present positions might be quite different from the one that has traditionally been assumed.

Figure 4 is a structural sketch map of the western Alps published a few years ago (J. Delbelmas and M. Lemoine*). On this map the area studied can easily be replaced in the general context of the Franco-Italian Alps. The sketch does not reveal any linear fracture, but several of them are drawn on figure 4 published later by the same two geologists. The limits of ERTS photo n°1078-09562 are drawn on both figure 3 and 4.

GEOLOGICAL SKETCH OF THE AREA DESCRIBED

This area is undoubtedly among one of the areas in the world more visited by geologists during the last century. The number of published papers about the geology of the western Alps is more than one thousand.

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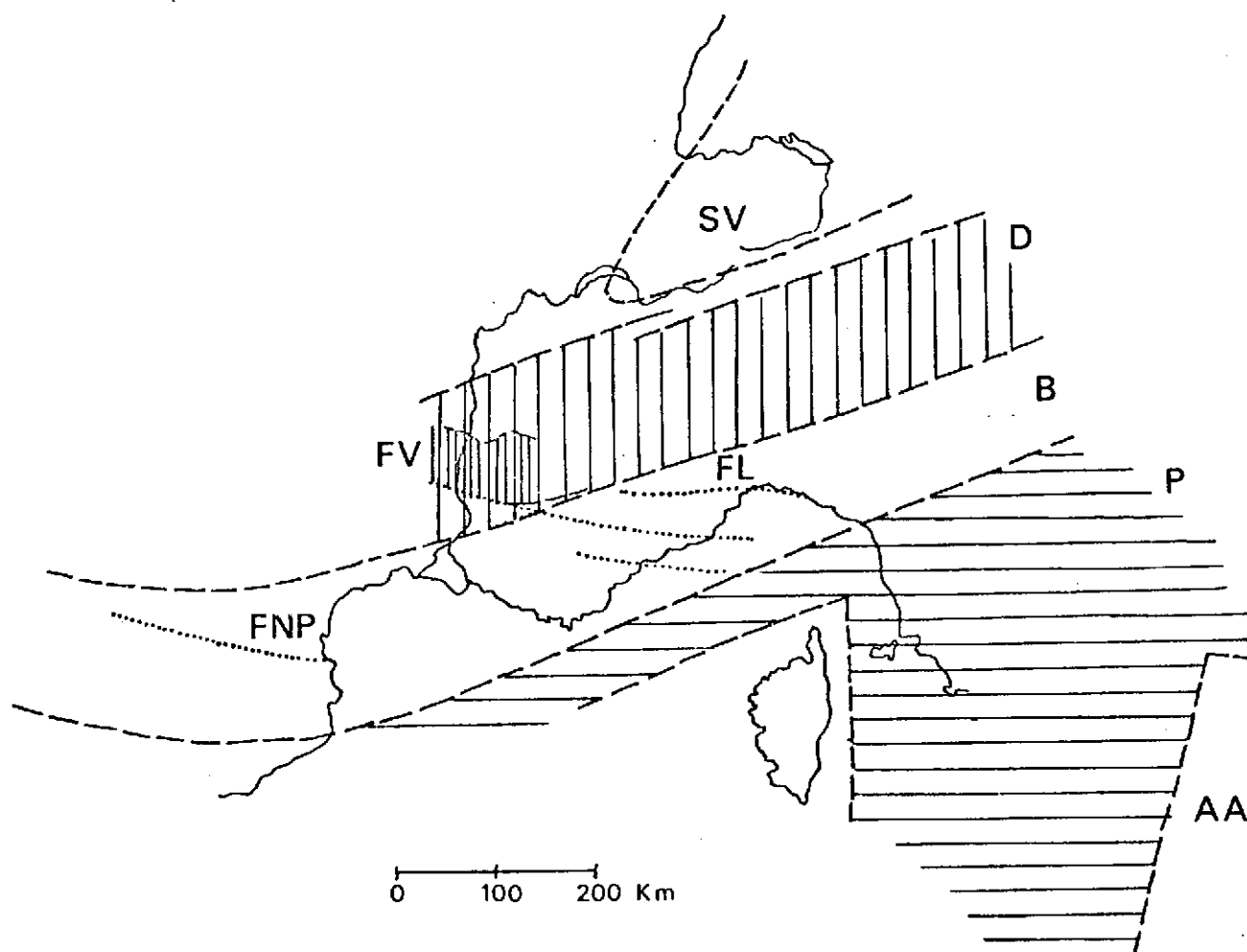


Fig. 7 - Palinspatic reconstitution of North-Apennine and Alpine domain in upper cretaceous, from Laubscher (1971) modified by Debeltmas (1972).

D = Dauphiné zone (VF = Vocontian Trough)

B = Briançonnais, s.l. P = Piemont zone

AA = Austro-Alpine

SV = Old Vindelician Uplift

FL = "Ligurian Fault" of Laubscher

FNP = North Pyrenean front

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The selected example is part of area shown by photo n°1078-09562 of Oct.9,1972. This photo represents the valley of the lower Rhone, south of the city of Lyons and north of its Delta. There the Rhone runs from north to south and its valley, partially filled by alluvial deposits, separates the Massif Central in the west and the Alps in the east.

The Massif Central is a large uplift of metamorphosed rocks, mainly of Hercynian age, covered by a thin, deeply dissected layer of sedimentary rocks of Mesozoic age. The rise of the uplift was contemporaneous to the Alpine folding and accompanied by volcanism (Chaine des Puys) and formation of meridian troughs (Limagne). On its eastern border, the sedimentary rocks gently dip southeast although cut by numerous faults.

The Alps differ from the Massif Central by a thick severely-folded sedimentary sequence of Mesozoic and Cenozoic ages.

Several provinces have been separated by Alpine geologists, and, as can be seen in Figure 4, the westernmost part of the French Alps, represented by ERTS photo 1078-09562, is in the outer province (domaine externe) where are distinguished a "zone dauphinoise" in the north and a "zone provençale" in the south.

One of the outer crystalline massifs (Pelvoux, Belledonne) lies in the northeastern corner of the photo.

The "zone dauphinoise" is characterized by folds trending north-south in opposition to the "zone provençale" where the axis of the fold is east-west.

As in the border the Massif Central, west of the Rhone, and in spite of a much more complicated tectonics it is possible to point out numerous linear features (fig. 6). Their trends are identical, mainly N 50°E to N 60°E, and directions between N 30° E and N 40° E are also present. They are mainly traces of faults but in some places they are also flexures or geomorphological lines.

In the southeastern part of the photo a linear feature more than 100 km long trends N 80°E. This trend is also represented southward in Provence. It is not a fault line but the axis of a narrow anticline slightly faulted (Luberon anticline) prolonged by a straight line valley (Asse River) beyond a large valley (Durance) trending N 30° E. It is the "Ligurian Fault" as indicated in paragraph c., and whose existence was forecast by Laubscher (5), (fig.7).

5 - CONCLUSION

Carrying on a project whose objective was to study the relationships between the Alps and the Pyrenees (Southern France), ERTS photos of the Western French Alps have been carefully examined for tectonic interpretation. From this survey it appears that ERTS photos obviously show up some large features which in the field are often hidden by small complicated structures. In the example, these features trending SW-NE (N 30° E to N 60°E) are tentatively interpreted as reflections of deep-seated wrench faults in the basement of the folded sedimentary series.

.../...

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ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

18

DATE 20 décembre 1972

PRINCIPAL INVESTIGATOR Jacques GUILLEMOT

GSFC 009.03

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	GEOLOGY	VEGETATION	FAULT	
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1075-09390-4	✓	✓		SNOW, PARALLEL DRAIN- AGE, AGRICULTURE
1075-09390-5	✓	✓	✓	SNOW, PARALLEL DRAIN- AGE, AGRICULTURE
1075-09390-6	✓		✓	LAKE, URBAN AREA
1075-09390-7	✓		✓	HIGHWAY, LAKE, URBAN AREA

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ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

DATE DEC 10 1972

PRINCIPAL INVESTIGATOR Max GUY

GSFC ID 009 01

ORGANIZATION IFP

NDPF USE ONLY

D _____

N _____

ID _____

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	GEOLOGY	VEGETATION	FAULT	
1076-09442-M			✓	SNOW, VALLEY LAKE, MOUNTAIN PIEDMONT PLAIN, ALLUVIAL PLAIN, FAULT, GLACIER
1076-09442-5	✓	✓		AGRICULTURE GLACIER
1076-09442-6			✓	RIVER, URBAN AREA, HIGHWAY
1076-09442-7				RIVER, URBAN AREA, HIGHWAY
1076-09442-4	✓	✓		

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

MAIL TO NDPF USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

ERTS IMAGE DESCRIPTOR FORM
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DATE DEC 9 1972

PRINCIPAL INVESTIGATOR MAX GUY

GSFC 009-01

ORGANIZATION IFP

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ID _____

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	GEOLOGY	VEGETATION	FAULT	
1076.09445. M				SEA MOUNTAIN, PIEDMONT PLAIN, CLOUD, COAST LINE
1076-09445-4	✓	✓		PARALLEL DRAINAGE, RUNOFF
1076-09445-5	✓	✓		AGRICULTURE, HARBOR, RUNOFF, PARALLEL DRAINAGE
1076-09445-6	✓		✓	URBAN AREA, RIVER, HARBOR, DENDRITIC DRAINAGE, LAKE, AGRICULTURE
1076-09445-7	✓		✓	URBAN AREA, RIVER, HARBOR, DENDRITIC DRAINAGE, LAKE, AGRICULTURE

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PRINCIPAL INVESTIGATOR Jacques GUILLEMOT

GSFC 009 03

ORGANIZATION INSTITUT FRANÇAIS DU PETROLE

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ID _____

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	GEOLOGY	VEGETATION	FAULT	
1076-09451-M				CLOUD, COAST LINE BAY, CAPE, ISLAND, RIVER ESTUARY, DENDRITIC DRAINAGE
1076-09451-4	✓			RUNOFF, HAZE
1076-09451-5	✓	✓		RELIEF
1076-09451-6	✓		✓	URBAN AREA
1076-09451-7	✓		✓	URBAN AREA

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D N ID

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	GEOLOGY	VEGETATION	FAULT	
1078-09555-M	✓		✓	LAKE, RIVER, SNOW, DENDRITIC DRAINAGE, MOUNTAIN, VALLEY, ACTIVE GLACIER
1078-09555-4	✓	✓	✓	
1078-09555-5	✓	✓	✓	
1078-09555-6	✓		✓	URBAN AREA
1078-09555-7	✓		✓	URBAN AREA

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